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NUTRITION RECOMMENDATION SYSTEM USING GENETIC ALGORITHM

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Abstract: The general recommendations for addressing non-communicable diseases, are mainly related to lifestyle changes, such as diet and physical activity. The overall aim of this project is to design, develop and evaluate a recommendation system which are able to assess dietary intake, using a validated Food Frequency Questionnaire (FFQ), and propose valid personalized nutrition advice for adults. It is investigating an effective way for providing personalized dietary recommendations to increase diet quality at population-level and of considering an individual user’s preferences, population data and expert’s knowledge in the recommendation. The system is envisaged to be a web-based service, built with commercially available technologies, scalable, replicable and inexpensive system.

Keywords: recommendations system, nutrition’s, personalized nutrition advice.

I. INTRODUCTION

Non-communicable diseases such as diabetes and cardiovascular diseases account for almost two thirds of deaths globally. The general recommendations for addressing these epidemics are related to lifestyle changes, mainly encouraging healthy diets, physical activity (PA) and the reduction of tobacco use and alcohol consumption. The majority of nutrition consultations in public services are only available for the people with diagnosed conditions such as diabetes and obesity. There is a need for preventative initiatives for the general population, which are currently focused on public guidelines only. A nutrition consultation cycle can be simplified in three steps: Assessment, Decision-making and provision of Advice.

. Typically, a person’s dietary intake is assessed and then it is used as an input for decision-making, in order to provide feedback to the person. Developing an online system for personalized nutrition, all those three steps were important. Regarding the assessment stage, a valid method for dietary intake recording is a key. An important nutrition assessment method is the Food Frequency Questionnaire (FFQ). It has been used in epidemiological studies for decades. With this method, participants are asked to indicate frequencies and portion sizes for foods that they have consumed during a period of time (e.g. over the last month). FFQs have some accuracy limitations, for example calorie estimation, but, relative to some other methods such as 4-day food diaries, are more appropriate for initial dietary assessments aiming at personalized nutrition; FFQs are able to capture habitual dietary intake patterns, which are completed in a relatively
short time by participants, and lend themselves to automated data processing.

After a person has completed the Food Frequency Questionnaire (FFQ), researchers and nutrition professionals typically use guidelines to evaluate the diet quality of an individual. They may calculate the energy and nutrient content of the person’s diet and compare the calculations with current nutritional guidelines, in order to guide decision-making. However, food composition tables can contain more than the hundreds of nutrient and analysis of a person’s nutrient profile can be complex and difficult to summarize, which are useful for dietary advice.

To address this challenge, a number of indexes of the diet quality have been developed over the last decades. Some of the indexes were focused on local guidelines and others on specific target groups or diseases. One particular index of interest for this project is the United States Department of Agriculture (USDA)’s, Healthy Eating Index (HEI), and the most recent version was published in the year 2015. In some of the cases, specific indexes have been created to correlate with particular diseases, such as the Alternative Healthy Eating Index (AHEI) which claims to predict the risk of chronic diseases, which is the main nutritional issue to be targeted by the system proposed in this project.

II. RELATED WORKS

Rodrigo Zenun Franco (2017) design, developed a recommender system able to assess dietary intake, using a validated Food Frequency Questionnaire (FFQ), and propose valid personalized nutrition advice for adults. It is investigating an effective way for providing personalized online dietary recommendations which is to increase the diet quality of population-level and considering the population’s data, individual user’s preferences, and expert’s knowledge in the recommendation. The system is envisaged to be a web-based service, built with commercial available technologies which are scalable, reproduceable, inexpensive and independent of any bespoke device, example - proprietary activity trackers. Different levels of personalized advice will be evaluated via an online Randomized Control Trial (RCT) and surveys with nutrition professionals will be used for rating the advice proposed by the recommendation system.

Madhu Raut et al (2018) proposed system; we are using fuzzy ontology, rule-based reasoning, artificial bee colony algorithm and genetic algorithm for suggesting nutrients diet and recipes based on the suggested diet plan. We also take seasonal availability of food available in India and preexisting conditions of the users of the system. Due to unhealthy and haphazard eating habits, the spread of diet related diseases is at an all-time high. In India, more than 2 out of every 100 people suffer from diabetes, while 32 out of every 100 people suffer from coronary heart disease. In Urban Areas, the prevalence of these diseases is even more. There are a host of diet related applications and solutions available today.

Sonja Wendel et al (2013) investigate consumer’s evaluation of hypothetical health recommendation systems that provide personalized nutrition advice. We examine consumer’s intention to use such a health recommendation system as a function of options related to the underlying system, for example, the type of company that generates the advice, as well as intermediaries that might assist in using the system. We further explore if the effect of both the system and intermediaries on intention to use a health recommendation system are mediated by consumer’s perceived effort, privacy risk, usefulness and enjoyment.
Nadja Leipold et al (2018) propose a mobile nutrition assistance system that specifically makes use of personalized persuasive features based on nutritional intake that could help users to adapt their behavior towards healthier nutrition. In a pilot study with 14 participants using the application for 3 weeks we investigate how the different features of the overall system are used and perceived. Based on the measurements, we examine which functions are important to the users and determine necessary improvements. While an automated recommender system for nutrition could provide great benefits compared to human nutrition advisors, it also faces a number of challenges in the area of usability like efficiency, efficacy and satisfaction.

Thi Ngoc Trang Tran et al (2017) present an overview of recommendation techniques for individuals and groups in the healthy food domain. In addition, we analyze the existing state of the art in the food recommendation system and discuss those research challenges, which are related to the development of future food recommendation technologies. These systems will also provide functionalities to keep track of all nutritional consumption as well as to persuade users to change their eating behavior in all the positive ways. Also, group recommendation functionalities are very useful in the food domain. For example, when a group of users wants to have a dinner together at home or have a birthday party in a restaurant. Such scenarios create many challenges for food recommendation systems, since all the preferences of the group members have to be taken into an account in an adequate fashion.

III. PROPOSED METHODOLOGY
The proposed flow diagram is shown in figure 1. The collected product data is further categorized using deep neural network. Further the analyzed data is recommended to the user based on the genetic algorithm.

IV. DEEP NEURAL NETWORK FOR PRODUCT CATEGORIZATION
Neural networks take their inspiration from the notion that a neuron’s computation involves a weighted sum of the input values. These weighted sums corresponds to the value scaling which are performed by the synapses and the combining of those values in the neuron. Further more, the neuron doesn’t just output that a weighted sum, since the computation associated with a cascade of neurons would be a simple linear algebraic operations. Instead, there is a functional operation within which the neuron that is performed on the combined inputs. This operation appears to be a non-linear function which causes a neuron to generate an output, only if, the inputs cross some threshold. Thus by analogy, a neural networks apply a non-linear function to the weighted sum of the input values. Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) have emerged as two widely used architectures in deep neural networks (DNNs). CNNs have excellent performance in extracting features of different positions within the data and they can learn the relationships between positions and features through an operation called max-pooling. However, they are not designed to handle sequences of the data or to capture long-term
dependencies. On the other hand, RNNs are specialized for sequential modeling, which are ideal for learning. The neurons are in the input layer receive some values and propagate them to the neurons in the middle layer of the network, which is also frequently called a ‘hidden layer’. The weighted sum from one or more hidden layers are ultimately propagated to the output layer, which presents the final outputs of the network to the user. To align brain-inspired terminology with neural networks, the outputs of the neurons are often referred to as activations, and the synapses are often referred to as weights the computation at each layer.

\[ y_j = f \left( \sum_{i=1}^{3} W_{ij} \times x_i + b \right) \]

Where \( W_{ij}, x_i \) and \( y_j \) are the weights, input activations and output activations, respectively, and \( f(\cdot) \) is a non-linear function.

V. GENETIC ALGORITHM

A genetic algorithm is a search heuristic solution that inspired by Charles Darwin’s theory of natural evolution. The genetic algorithm defines the process of natural selection (its produce offspring which inherit the characteristics of the parents), where the fittest individuals are selected for reproduction in order to produce offspring of the next generation.

Step 1: randomly initialize population(t)

Step 2: determine fitness of population(t)

Step 3: repeat

1. select parents from population(t)
2. perform crossover on parents creating population(t+1)
3. perform mutation of population(t+1)
4. determine fitness of population(t+1)

2. until best individual is good enough

VI. ALGORITHM STEPS:

Step 1: randomly initialize population(t)

Figure 1. Genetic Algorithm diagram

Figure 2. Genetic Algorithm concept

VII. EXPERIMENTAL RESULT

The performance evaluation of the proposed work is discussed in this section. The nutrition product dataset is collected from data world repository. Then the user health data is collected through questionnaire. The implementation is developed in Netbeans IDE using java language. The MYSQL database is utilized for database access. The experiment evaluation of the research is shown in the following results.
VIII. CONCLUSION

This proposed method is mainly to recommend the food items which are based on the calories content of that particular grocery product. The calories of each of the product is calculated through Heuristic Solution, proposed by Charles Darwin and those product categorizations, are done by Deep Neural Network and product recommendations by Genetic Algorithm.

REFERENCES


